Metal Fabrication Technology

Program of Studies
2015-2016

Office of Career and Technical Education
Kentucky Department of Education

Metal Fabrication Technology

Program Area Course Title	Post-Secondary Connection	Valid Course Code	Recommended Grade Level				Recommended Credit
			9	10	11	12	
Co-op I (Metal Fab)		480803			X	X	1
Co-op II (Metal Fab)		480804			X	X	2
Co-op III (Metal Fab)		480805			X	X	3
Internship (Metal Fab)		480806			X	X	1-3
Metal Trade Information and Metals		480816		X	X	X	.5
Parallel Line Layout		480813	X	X	X	X	1
Radial Line Development		480814		X	X	X	1
Sheet Metal I - A		480817		X	X	X	1
Sheet Metal I - B		480818		X	X	X	1
Sheet Metal II - A		480819		X	X	X	1
Sheet Metal II - B		480820		X	X	X	1
Special Projects I (Metal Fab)		480879		X	X	X	1

Last revised May 15, 2015

Overview of Metal Fabrication Technology

Purpose
The vision of Metal Fabrication Technology is to promote safety standards and performance standards, enhance leadership skills, and provide relevant curriculum vital to the education of all students.

Metal Fabrication Technology will:

- Operate as the venue for nationally recognized industry standard training.
- Provide a critical link in school to employment or postsecondary education.
- Develop stronger relationships with the community in terms of mutual advocacy, cooperative field experiences, employment placement, and support for relevant student organizations and competitions
- Represent an important component in the education of all students.
- Require and promote critical thinking and problem solving.
- Offer an up to date curriculum based on standards that adapt to changes in the industry.
- Integrate academic skills to insure that students develop written and verbal communications skills, computational skills, and scientific/math problem-solving skills.

Career Pathways

- *Sheet Metal Technician*
- *Metal Fabrication TRACK*

Standards Based Curriculum
The Metal Fabrication Technology curriculum is composed of standards-based competencies. All Metal Fabrication Technology programs incorporate industry and common core standards thus increasing the student's qualifications toward successful employment.

Alignment of the Metal Fabrication Technology curriculum with nationally recognized industry standards and the common core standards provides optimal preparation for students to acquire an industry certification.

Communities understand that this preparation provides better career opportunities for students and the demands of today's workforce for the 21st century.

Kentucky Occupational Skill Standards
The Kentucky Occupational Skill Standards are the performance specifications that identify the knowledge, skills, and abilities an individual needs to succeed in the workplace. Identifying the necessary skills is critical to preparing students for entry into employment or postsecondary education. These standards describe the necessary occupational, academic, and employability skills needed to enter the workforce or post-secondary education in specific career areas. There is an ongoing effort to continue to refine these standards by which exemplary Career and Technical Education Programs are evaluated and certified. This helps insure that curriculum meets industry specifications.

2014 – 2015 Valid Industry Certification and KOSSA List

Work Based Learning
Cooperative experience, internships, shadowing and mentoring opportunities provide depth and breadth of learning in the instructional program and allow students to apply the concepts learned in the classroom. The Work Based Learning Manual is available on the KDE webpage: www.education.ky.gov.

Student Organizations and Competitions
Participation in SkillsUSA competitions provides a vehicle for students to employ higher order thinking skills, interact with high-level industry representatives and enhance leadership skills through participation in regional, state and national competitive events and activities.

METAL FABRICATION CAREER PATHWAYS
2015-2016

SHEET METAL TECHNICIAN
CIP 48.0506.01

PATHWAY DESCRIPTION: The Sheet Metal Technician creates parts to the specifications required through line development and fabrication. Sheet metal is measured and sheet metal patterns are cut and formed for the determined available space. Sheet metal technicians must have strong math skills for the development of geometrical parts. The sheet metal technician provides direct support to manufacturing for the design, fabrication, modification, and evaluation of parts, assemblies, components and sub-assemblies according to specifications.

BEST PRACTICE CORE	**EXAMPLE ILP-RELATED CAREER TITLES**
Foundational Skills Necessary for Career-Ready Measure: (KOSSA/Industry Certification) *Complete **(4) FOUR CREDITS:*** • 480816 Metal Trade Information and Metals • 480813 Parallel Line Layout • 480817 Sheet Metal 1-A • 480818 Sheet Metal 1-B • 480803 Co-op I (Metal Fab) OR 480806 Internship (Metal Fab)	Sheet Metal Production Technician Sheet Metal Mechanic Fabrication Technician Layout Technician Precision Sheet Metal Technician Manufacturing Engineer Sheet Metal Engineer

METAL FABRICATION CAREER PATHWAYS
2015-2016

METAL FABRICATION TRACK
CIP 48.0500.99

PATHWAY DESCRIPTION: The Metal Fabrication TRACK is designed as a pre-apprenticeship pathway for technical students to enter industry. Through the collaboration of local industry, technical school, program instructor, student and parents, a pre-apprenticeship agreement is signed. Local industry chooses 4 courses related to the required skills that will prepare the student to enter a four year apprenticeship sponsored by the company. Upon graduation the student under the discretion of the company; may be awarded reduced apprenticeship time or start at a higher wage.

BEST PRACTICE CORE	**EXAMPLE ILP-RELATED CAREER TITLES**
Foundational Skills Necessary for Career-Ready Measure: (KOSSA/Industry Certification) *Complete **(4) FOUR CREDITS:*** • (4)- Core courses chosen from the Metal Fabrication valid course list by the company sponsoring a State Registered Apprenticeship.	Sheet Metal Production Technician Sheet Metal Mechanic Fabrication Technician Layout Technician Precision Sheet Metal Technician Manufacturing Engineer Sheet Metal Worker Sheet Metal Engineer

The Tech Ready Apprentices for Careers in Kentucky (*TRACK*) pre-apprenticeship program is a partnership between The Kentucky Department of Education's Office of Career and Technical Education and The Kentucky Labor Cabinet to provide pre-apprenticeship career pathway opportunities into registered apprenticeship programs to secondary students. This is a business and industry driven program to create a pipeline for students to enter post-secondary apprenticeship training.

Upon successful completion, the student will be awarded an industry certification by the employer or training organization through The Kentucky Labor Cabinet and all on-the-job hours worked will be counted towards the apprenticeship, if applicable. The certification will also count towards the local school district's college and career ready accountability index.

The specifics of the TRACK program vary and interested parties will need to confer with the Office of Career and Technical Education for the implementation process. There are no costs involved except wages for the student employee. The employer must have a registered apprenticeship program with The Kentucky Labor Cabinet. For more information, please refer to: http://education.ky.gov/CTE/cter/Pages/TRACK.aspx

As career pathways continue to expand, the ultimate rationale is that if an employer is willing to implement a Registered Apprenticeship program, a pipeline at the secondary level can be developed utilizing the TRACK program.

COMPLEMENTARY OR ADVANCED COURSEWORK BEYOND THE METAL FAB PATHWAY(s)
Upon completion of a pathway, additional coursework to enhance student learning is encouraged. Credits earned in Advanced or Complementary Coursework "Beyond the Pathway" may not be substituted for pathway courses in order to achieve Preparatory or Completer status.
• 480819 Sheer Metal II-A
• 480820 Sheet Metal II-B
• 480814 Radial Line Development
• Career Options
• JAG Courses

KENTUCKY CAREER PATHWAY/PROGRAM OF STUDY TEMPLATE

COLLEGE/UNIVERSITY Kentucky College/University/KCTCS

CLUSTER: Manufacturing

PATHWAY: Manufacturing Management

HIGH SCHOOL (S): Boone County ATC School

PROGRAM: Metal Fabrication

GRADE	ENGLISH	MATH	SCIENCE	SOCIAL STUDIES	REQUIRED COURSES RECOMMENDED ELECTIVE COURSES OTHER ELECTIVE COURSES CAREER AND TECHNICAL EDUCATION			CREDENTIAL CERTIFICATE DIPLOMA DEGREE	SAMPLE OCCUPATIONS
9	English I	Algebra I	Earth Scie	Economics	History	Health & PE			
10	English II	*See Construction Geometry	Biology	U.S. History	World Geography	Metal Trade Info. & Metals 480816 / MFT 100	Parallel Line Layout 480813 / MFT 200		
11	English III	Algebra II	Physical Science	World Civics	Sheet Metal 1-A 480817 / MFT 240	Sheet Metal 1-B 480818 / MFT 242	Development 480814 / MFT 210		
12	English IV	4th Math	Elective	Elective	Sheet Metal II-A 480819 / MFT 270	Sheet Metal II-B 480820 /MFT 272	Special Projec	NCCER Certification / TRACK Pre-Apprenticeship	Sheet Metal Technician
	Take ACT - Apply for admission to Northern Kentucky University								
Year 13	Writing	Math	Science	Computer Applications	Materials and Methods of Construction	Intro to Construction	Estimating		
Year 14	Communications	Math	Humanities	Social Interaction	Plane Surveying	Managerial Reports	Soils and Foundations		
Year 15	Communications	Humanities	Psychology	Economics	Construction Contracts	Estimating II	Occupational Safety		
Year 16	Arts and Humanities	Math	Science		Structural Systems	Strength of Materials	Surveying	Bachelor's Degree	Construction Manager

Required Courses

Recommended Elective Courses

Other Elective Courses

Career and Technical Education Courses

Credit-Based Transition Programs (e.g. Dual/Concurrent Enrollment, Articulated Courses, 2+2+2)

(◆ =High School to Comm. College) (● =Com. College to 4-Yr Institution) (■ = Opportunity to test out)

Mandatory Assessments, Advising, and Additional Preparation

Funded by the U. S. Department of Education
(V051B020001)
Revised Jan. 2005
October, 2006-CTE/Kentucky

Note: Categories of courses (e.g. Required, Recommended Electives, other Electives and career and Technical Education) apply to both secondary and postsecondary levels.

Co-op I (Metal Fab)
Valid Course Code: 480803

Course Description: Cooperative Education provides supervised on-the-job work experience related to the student's educational objectives. Students participating in the Cooperative Education program receive compensation for their work.

Prerequisites: Permission of the Instructor

Content/Process

Students will:

1. Gain career awareness and the opportunity to test career choice(s).
2. Receive work experience related to career interests prior to graduation.
3. Integrate classroom studies with work experience.
4. Receive exposure to facilities and equipment unavailable in a classroom setting.
5. Increase employability potential after graduation.
6. Earn funds to help finance education expenses.

Connections

- Common Core Standards
- KOSSA
- Common Core Technical Standards
- New Generation Science Standards
- NCCER Industry Certifications
- CTSO - SkillsUSA

Co-op II (Metal Fab)
Valid Course Code: 480804

Course Description: Cooperative Education provides supervised on-the-job work experience related to the student's educational objectives. Students participating in the Cooperative Education program receive compensation for their work.

Prerequisites: Permission of the Instructor

Content/Process

Students will:

1. Gain career awareness and the opportunity to test career choice(s).
2. Receive work experience related to career interests prior to graduation.
3. Integrate classroom studies with work experience.
4. Receive exposure to facilities and equipment unavailable in a classroom setting.
5. Increase employability potential after graduation.
6. Earn funds to help finance education expenses.

Connections

- Common Core Standards
- KOSSA
- Common Core Technical Standards
- New Generation Science Standards
- NCCER Industry Certifications
- CTSO - SkillsUSA

Co-op II (Metal Fab)
Valid Course Code: 480805

Course Description: Cooperative Education provides supervised on-the-job work experience related to the student's educational objectives. Students participating in the Cooperative Education program receive compensation for their work.

Prerequisites: Permission of the Instructor

Content/Process

Students will:

1. Gain career awareness and the opportunity to test career choice(s).
2. Receive work experience related to career interests prior to graduation.
3. Integrate classroom studies with work experience.
4. Receive exposure to facilities and equipment unavailable in a classroom setting.
5. Increase employability potential after graduation.
6. Earn funds to help finance education expenses.

Connections

- Common Core Standards
- KOSSA
- Common Core Technical Standards
- New Generation Science Standards
- NCCER Industry Certifications
- CTSO - SkillsUSA

Internship (Metal Fab)
Valid Course Code: 480806

Course Description: Internship provides supervised on-the-job work experience related to the student's educational objectives. Students participating in the Internship do not receive compensation.

Prerequisites: Permission of the Instructor

Content/Process

Students will:

1. Gain career awareness and the opportunity to test career choice(s).
2. Receive work experience related to career interests prior to graduation.
3. Integrate classroom studies with work experience.
4. Receive exposure to facilities and equipment unavailable in a classroom setting.
5. Increase employability potential after graduation.

Connections

- Common Core Standards
- KOSSA
- Common Core Technical Standards
- New Generation Science Standards
- NCCER Industry Certifications
- CTSO - SkillsUSA

Metal Trade Information and Metals
Valid Course Code: 480816

Course Description: A series of lectures and demonstrations of hand tools, use of machinery in the shop, and various types of metal and their uses in the metal trade will be discussed.

Prerequisites: None

Content/Process

Students will:

1. Apply work site and lab safety procedures.
2. Apply personal safety rules and procedures.
3. Apply fire prevention rules and procedures.
4. Demonstrate hazardous communication procedures.
5. Describe and demonstrate universal precaution procedures.
6. Identify common sheet metal fabrication hand tools.
7. Demonstrate proper use of common sheet metal fabrication hand tools.
8. Obtain First Aid certification.
9. Obtain CPR certification.
10. Use and care for tools and equipment.
11. Select appropriate sheet metal gauges.
12. Select specified types of sheet metals.

Connections

- Common Core Standards
- KOSSA
- Common Core Technical Standards
- New Generation Science Standards
- NCCER Industry Certifications
- CTSO - SkillsUSA

Parallel Line Layout
Valid Course Code: 480813

Course Description: This course introduces the parallel line method of developing the pattern for an object. In addition, this course presents basic applied math, lines, multi-view drawings, symbols, various schematics and diagrams, dimensioning techniques, sectional views, auxiliary views, and sketching typical to sheet metal drawings. Safety will be emphasized as an integral part of the course.

Prerequisites: Metal Trade Information and Metals - 480816

Content/Process

Students will:

1. Identify the purposes for parallel line layout.
2. Identify parts fabricated with parallel line layout methods.
3. Use the parallel line method to lay out sheet metal patterns.
4. Identify hand tools required for parallel line layout development.
5. Measure sheet metal to determine the available space for assembly pattern.
6. Select appropriate sheet metal gauge.
7. Form sheet metal assemblies with bench stakes and mallets.
8. Introduction and math review (fractions and decimals).
9. Identify line types used in combinations.
10. Identify multiple views.
11. Arrange multiple views.
12. Demonstrate visualizing techniques of multiple views.
13. Identify one view drawing.
14. Arrange and identify auxiliary views.
15. Demonstrate the use of size and location dimensions.
16. Identify standard listings on working drawings.
17. Size dimensions of holes and angles.
18. Locate dimensions for centering of holes, points, and centers.
19. Identify half, full, and removed sections.
20. Identify usages for chamfers and interpret sizes.
21. Sketch oblique views of various parts.
22. Sketch and dimension shop drawings.

Connections

- Common Core Standards
- KOSSA
- Common Core Technical Standards
- New Generation Science Standards
- NCCER Industry Certifications
- CTSO - SkillsUSA

Radial Line Development
Valid Course Code: 480814

Course Description: Radial Line Development uses many of the procedures of parallel line development and triangulation. The student will learn to develop patterns from any centered, round or square taper, using the radial line method.

Prerequisite: Parallel Line Layout - 480813

Content/Process

Students will:

1. Apply safety rules and procedures.
2. Use and care for tools and equipment.
3. Interpret building trades blueprints.
4. Measure sheet metal to determine the available space for assembly pattern.
5. Use the radial line method to lay out sheet metal patterns.
6. Select sheet metal gauges for patterns.
7. Cut sheet metal with aviation snips.
8. Cut sheet metal with straight snips.
9. Fabricate residential and commercial heating and air conditioning duct work.

Connections

- Common Core Standards
- KOSSA
- Common Core Technical Standards
- New Generation Science Standards
- NCCER Industry Certifications
- CTSO - SkillsUSA

Sheet Metal I – A
Valid Course Code: 480817

Course Description: This course introduces the student to figuring drawings of plans for a duct system and also learning how to fabricate the ducts.

Prerequisites: Parallel Line Layout - 480813

Content/Process

Students will:

1. Measure sheet metal to determine available space for assembly patterns.
2. Use the radial line method to lay out sheet metal patterns.
3. Use the triangular method to lay out sheet metal patterns.
4. Use the parallel line method to lay out sheet metal patterns.
5. Select sheet metal gauges for patterns.
6. Select types of sheet metals.
7. Cut sheet metal layouts with aviation snips.
8. Cut sheet metal layouts with bulldog snips.
9. Cut sheet metal layouts with circular snips.
10. Cut sheet metal layouts with combination snips.
11. Cut sheet metal layouts with double-cut snips.
12. Cut sheet metal layouts with straight snips.
13. Store tools.
14. Cut sheet metal with hand notchers.
15. Cut sheet metal with combination notchers.
16. Cut sheet metal with squaring shears.
17. Cut sheet metal with universal metal cutters.
18. Bend sheet metal with hand seamers.
19. Form sheet metal assemblies with blow horn stakes and mallets.
20. Form sheet metal assemblies with conductor stakes and mallets.
21. Form sheet metal assemblies with common squares and mallets.
22. Form sheet metal assemblies with creasing stakes and mallets.
23. Form sheet metal with the slip-roll to create cylindrical shape.
24. Form single and double hems on sheet metal layouts with brake.
25. Turn edges of sheet metal elbow assemblies with an elbow edging machine.
26. Form sheet metal assemblies with hollow mandrel stakes and mallets.
27. Form sheet metal assemblies with mandrel stakes and mallets.
28. Form sheet metal assemblies with needle case stakes and mallets.
29. Fabricate residential and commercial heating and air conditioning duct work.
30. Cut sheet metal layouts with do-all saws.
31. Cut sheet metal layouts with hacksaws.

Connections

- Common Core Standards
- KOSSA
- Common Core Technical Standards
- New Generation Science Standards
- NCCER Industry Certifications
- CTSO - SkillsUSA

Sheet Metal I – B
Valid Course Code: 480818

Course Description: This course provides advanced training in designing and interpreting plans for a duct system and advanced fabrication of duct systems and precision sheet metal concepts.

Prerequisites: Sheet Metal I – A - 480817

Content/Process

Students will:

1. Measure sheet metal to determine available space for assembly patterns.
2. Use the radial line method to lay out sheet metal patterns.
3. Use the triangular method to lay out sheet metal patterns.
4. Use the parallel line method to lay out sheet metal patterns.
5. Select sheet metal gauges for patterns.
6. Select types of sheet metals.
7. Cut sheet metal layouts with aviation snips.
8. Cut sheet metal layouts with bulldog snips.
9. Cut sheet metal layouts with circular snips.
10. Cut sheet metal layouts with combination snips.
11. Cut sheet metal layouts with double-cut snips.
12. Cut sheet metal layouts with straight snips.
13. Store tools.
14. Make advanced sheet metal cuts with hand notchers.
15. Make advanced sheet metal cuts with combination notchers.
16. Make advanced sheet metal cuts with squaring shears.
17. Make advanced sheet metal cuts with universal metal cutters.
18. Make advanced sheet metal bends with hand seamers.
19. Form sheet metal assemblies with blow horn stakes and mallets.
20. Form sheet metal assemblies with conductor stakes and mallets.
21. Form sheet metal assemblies with common squares and mallets.
22. Form sheet metal assemblies with creasing stakes and mallets.
23. Form sheet metal with the slip-roll to create cylindrical shape.
24. Form single and double hems on sheet metal layouts with brake.
25. Make advanced sheet metal turned edges or elbow assemblies with an elbow edging machine.
26. Form advanced sheet metal assemblies with hollow mandrel stakes and mallets.
27. Form advanced sheet metal assemblies with mandrel stakes and mallets.
28. Form advanced sheet metal assemblies with needle case stakes and mallets.
29. Fabricate advanced residential and commercial heating and air conditioning duct work.
30. Glue insulation to the exterior and interior surfaces.
31. Install heating, ventilation, and air conditioning ducts.
32. Cut advanced sheet metal layouts with do-all saws.
33. Cut advanced sheet metal layouts with hacksaws.
34. Cut advanced sheet metal layouts with hawk-billed snips.
35. Identify capacities for the English Wheel.
36. Shape sheet metal parts with the English Wheel.
37. Smooth sheet metal parts with the English Wheel.

38. Shape sheet metal parts with the Shot Bag and Mallet.
Connections
• Common Core Standards • KOSSA • Common Core Technical Standards • New Generation Science Standards • NCCER Industry Certifications • CTSO - SkillsUSA

Sheet Metal II – A
Valid Course Code: 480819

Course Description: This course provides a series of lectures to improve skills in pattern development and fabrication of more difficult fittings.

Prerequisite: Sheet Metal I – B - 480818

Content/Process

Students will:

1. Apply safety rules and procedures.
2. Use and care for tools and equipment.
3. Interpret building trade blueprints.
4. Draw sheet metal assemblies.
5. Use the radial line method to lay out sheet metal patterns.
6. Use the triangular method to lay out sheet metal patterns.
7. Use the parallel line method to lay out sheet metal patterns.
8. Select sheet metal gauges for patterns.
9. Cut sheet metal with aviation snips.
10. Cut sheet metal with straight snips.
11. Cut sheet metal with squaring shears.
12. Turn edges of sheet metal elbow assemblies with an elbow turning machine.
13. Fabricate residential and commercial heating and air conditioning duct work.
14. Install heating, ventilation, and air conditioning ducts.
15. Install machine guards and assemblies.
16. Use signed numbers.
17. Apply algebraic symbols and terms.
18. Solve simple equations.
19. Solve problems in work-related problems and distinguish between direct and indirect relationships.
20. Perform and apply surface measurement calculations.
21. Use exponents and radical.

Connections

- Common Core Standards
- KOSSA
- Common Core Technical Standards
- New Generation Science Standards
- NCCER Industry Certifications
- CTSO - SkillsUSA

Sheet Metal II – B
Valid Course Code: 480820

Course Description: This course provides a series of advanced lectures to improve skills in advanced pattern development and fabrication of complicated fittings.

Prerequisite: Sheet Metal II – A - 480819

Content/Process

Students will:

1. Apply safety rules and procedures.
2. Use and care for tools and equipment.
3. Interpret building trade blueprints.
4. Draw advanced sheet metal assemblies.
5. Use the radial line method to lay out advanced sheet metal patterns.
6. Use the triangular method to lay out advanced sheet metal patterns.
7. Use the parallel line method to lay out advanced sheet metal patterns.
8. Select sheet metal gauges for patterns.
9. Cut sheet metal with aviation snips.
10. Cut sheet metal with straight snips.
11. Cut sheet metal with squaring shears.
12. Turn complicated edges of sheet metal elbow assemblies with an elbow turning machine.
13. Fabricate complicated residential and commercial heating and air conditioning duct work.
14. Install heating, ventilation, and air conditioning ducts.
15. Install machine guards and assemblies.
16. Cutting sheet metal parts on the Power Shear.
17. Use mechanical and computerized shear gauges.
18. Cutting sheet metal products on the band saw.
19. Use Die applications on the Power Brake.
20. Alignment and Die setting of Power Brake.
21. Introduction to Mig welding.
22. Use CNC Controlled Punch Press.
23. Program CNC Controlled Punch Press.

Connections

- Common Core Standards
- KOSSA
- Common Core Technical Standards
- New Generation Science Standards
- NCCER Industry Certifications
- CTSO - SkillsUSA

Special Projects I (Metal Fab)
Valid Course Code: 480879

Course Description: This is a course designed for the student who has demonstrated specific special needs. *Prerequisites: Radial Line Development - 480814*
Content/Process
Students will: 1. Apply work site and lab safety procedures 2. Describe and apply the problem-solving processes independently or in teams to sheet metal fabrication projects.
Connections
• Common Core Standards • KOSSA • Common Core Technical Standards • New Generation Science Standards • NCCER Industry Certifications • CTSO - SkillsUSA